4.1 ANALYSIS APPROACH

This section evaluates the potential effects of releases made under the proposed project operations relative to the baseline operations on steelhead passage opportunities, mainstem steelhead spawning and rearing habitat, and other aquatic resources. The steelhead evaluation includes the reaches of the Santa Ynez River downstream of Bradbury Dam (the upstream limit of steelhead) that may support steelhead. This analysis also looks at the streamflow conditions that would have been present at these locations if Bradbury Dam did not store water and if all inflow was passed through the reservoir. The analysis is based on the flows that would be present at specified locations along the river during wet, normal, and dry water year types. The three water year types are represented by the 20%, 50% and 80% exceedance flows under the three operating conditions: Historic, Baseline, and Proposed.

- The "Historic" condition represents the habitat conditions prior to the construction of Bradbury Dam (*i.e*., inflow passed through the reservoir).

- "Baseline" Operations represent the operation of the project as directed in SWRCB Decision WR 89-18. There is no Fish Reserve Account. The project diverts and stores water and makes deliveries to the Member Units and releases to satisfy the requirements of downstream users.

- The "Proposed" Operations include modification to the project to include the flow releases for the maintenance and enhancement of aquatic habitats and species downstream of the reservoir: conjunctive use of reservoir and downstream water rights releases to meet mainstem rearing target flows and Fish Passage Account releases. Adaptive Management Account releases cannot be directly quantified, as it is not known how this water will be used; therefore, these are not included in this analysis. Similarly, the provision to maintain residual pool depth in the Refugio and Alisal Reaches during the interim period is not included in the analysis. Proposed Operations include both Interim Operations (0.75 and 1.8-foot surcharge, where applicable) and Long-Term Operations.

4.2 EFFECTS OF FLOW-RELATED ENHANCEMENT MEASURES ON RAINBOW TROUT/STEELHEAD

4.2.1 SUMMARY OF EFFECTS

The effects of the Proposed Operations on steelhead were evaluated with respect to the potential effects on three lifestages: passage, mainstem spawning and mainstem rearing.

- **Passage** – In general, the Proposed Operations improve passage opportunities relative to the Baseline Operations (Section 4.2.2). The Historic Condition provides more passage opportunities than either the Proposed or Baseline Operations because water is not stored behind Bradbury Dam but flows directly to the sea. In just those years when passage flow supplementation would have occurred, the Proposed Operations (both interim and long-term) substantially increase the number of passage days over Baseline Operations; although, the number of passage days under the Proposed Operations is still lower than the Historical number of passage days.

- **Spawning Habitat** - The Proposed Operations provide substantially more mainstem spawning habitat in all three reaches between Bradbury Dam and Alisal Road in normal and dry years than the Baseline Operations (Section 4.2.3). The Historic Condition provides more spawning habitat in wet and normal years than the Proposed Operations, but less habitat in dry years, especially in the Refugio and Alisal reaches.

- **Rearing Habitat** - The Proposed Operations result in a substantial amount of additional rearing habitat (Section 4.2.4) being available relative to the Baseline Operation during all seasons in dry and normal years, and in July through December in wet years. In the first half of a wet year, the Proposed Operation provides a similar amount of rearing habitat to the Baseline Operation. These results were common to all three reaches. The Historic Condition provides more rearing habitat than the Proposed Operations from January through June in normal and wet years, but provides substantially less rearing habitat in the latter half of these years. This was particularly true of the Alisal Reach, where the proportion of pool habitat was lower than in the more upstream reaches.

The additional rearing habitat provided by the Proposed Operations relative to the Baseline Operations, in combination with the persistence of this habitat throughout the year even under dry conditions, provides a substantial benefit to steelhead over both Baseline Operations and Historic Conditions. Young-of-the-year rearing habitat was identified as a major limiting factor in the contract renewal EIS/EIR (Woodward-Clyde Consultants *et al*., 1995). Proposed Operations provide many times the amount of rearing habitat and provide it year round even in the typically dry months of July through November. In addition, the Proposed Operations provide additional passage opportunities and more spawning habitat than the Baseline Operations. Because of this, the Proposed Operations are judged to provide a greater net benefit to steelhead over Baseline Operations.

Although the Historic Condition provides more passage opportunities, greater spawning habitat (except in dry years), and more rearing habitat in the early part of the year, these benefits are likely lost in the latter portion of the year when rearing habitat is reduced below the level provided under the Proposed Operations. During the first part of the year, temperatures are relatively cool and, therefore, the metabolism of rainbow trout/steelhead is slower. These fish tend to reside in pools during the winter months when feeding is reduced, therefore habitat needs are less. In the April through June period, juvenile fish may be smolting and moving

downstream to the ocean when flows permit. Young-of-the-year fish, where present (they are emerging from the gravels during this time), are small and require less space. As the fish grow, they require more space, which may lead to a habitat bottleneck in the late summer or early fall when the amount of space required by each fish increases and the amount of space available decreases. Historic observations found that the mainstem river routinely dried in the summer downstream of Gibraltar Dam (except for a small, spring-fed reach around Solvang) (Shapovalov 1944). The greater availability of rearing habitat in the late summer and early fall likely provides a substantial benefit to steelhead relative to the Historic Condition in this portion of the river.

The perennial flows in the river under the Proposed Operations would likely result in the increased growth of willows and other riparian plant species. The increased growth of riparian plants would likely provide additional cover for steelhead and thus increase the carrying capacity of the river. The increased riparian growth may also shade the stream and help promote cooler water temperatures and reduce evaporation. Increased riparian growth may remove water from the stream through increased rates of evapotranspiration, but this is not likely to be of a magnitude that would adversely affect the steelhead population. Increased riparian vegetation may also require periodic maintenance which could result in some disturbance to the rearing habitat. Best management practices would be followed to avoid adverse effects to steelhead.

4.2.2 EFFECTS ON PASSAGE

The passage evaluation is based on the results of the passage study performed by the SYRTAC (1999b) and additional analyses (SYRTAC data). The analysis uses a minimum passage criterion of 8 feet of contiguous channel width with a depth of .6 feet. This criterion was selected based on the passage analysis performed by the SYRTAC (1999b) and observation of flows at which adult rainbow trout/steelhead were observed in Salsipuedes Creek during the 1999 migration season. A number of critical riffles were selected for study to determine minimum passage flow levels. Riffles were selected for evaluation because they represent the shallowest habitat type and thus would most likely represent low-flow passage barriers. The critical riffles were located in four areas (from downstream to upstream they are Lompoc Narrows, Cargasachi Reach, Alisal Reach, and Refugio Reach [SYRTAC 1999b]), and the flow that met minimum passage criterion was determined.

The minimum passage flow for the Alisal Reach (25 cfs) was used as an indicator of the availability of passage flows from Bradbury Dam to the ocean based on the critical riffle study (SYRTAC 1999b) and additional flow analysis. The 25 cfs criteria was selected for three reasons. First, 25 cfs provides passage flow over critical riffles in both the Alisal Reach and the more upstream Refugio Reach (SYRTAC 1999b). Second, 92% of the time when there is a flow of 25 cfs or more at the Solvang USGS gage (in the Alisal Reach), there is at least 15 cfs flowing in the Santa Ynez River upstream of the confluence with Salsipuedes Creek (*i.e.*, the Cargasachi Reach). Finally, passage flows at the critical riffles in the Lompoc Narrows are achieved 92% of the time that there is 25 cfs at Solvang based on USGS gaged data post

Cachuma construction (1953-1999). Taken together, these analyses support the assumption that 25 cfs at Alisal results in passage from the ocean to Bradbury Dam.

Prior to steelhead migrating upstream in the river itself, they must first be able to enter the river from the ocean. As discussed previously, the mouth of the Santa Ynez River is frequently closed by the presence of a sandbar. This bar forms during the summer when flows and wave energy are low. It is breached in the winter by a combination of higher river flows and greater wave energy (although either of these elements may be able to breach the bar by themselves). Little information is available regarding the frequency with which the bar is broken or what flows might be required to accomplish this. Flow from Salsipuedes Creek appears to be sufficient to breach the bar before sufficient flow is available in the mainstream. The bar has occasionally been opened manually, but this is not a regular practice due to concerns for the endangered tidewater goby inhabiting the lagoon. The passage analysis that follows presumes that steelhead have already gained access to the river.

The number of passage days provided, based on daily flows as modeled by the SYRHM (1942 to 1993) for the months of January through April, was calculated. This analysis tabulated the number of passage days, defined as a flow of 25 cfs or greater at Solvang (Alisal Reach), for each year under the Historical condition and Baseline and Proposed Operations. For the Proposed Operations, both the long-term (3,200 AF) and interim (2,500 AF) Fish Passage Account allocations were analyzed. For normal and dry years modeled, the Proposed Operations (both account allocations) provide more passage days than Baseline Operations. In wet years, the Proposed and Baseline Operations would provide similar passage opportunities. Historical conditions, however, still provide, on average, roughly 40% more passage days than either the Baseline or Proposed Operations. Although the Proposed and Baseline Operations do provide many passage opportunities for migrating steelhead, especially in wet years. The Adaptive Management Committee will work with NMFS to refine the passage supplementation protocol to reduce the number of dry years when supplementation occurs.

Supplementation occurs in years following surcharge years (typically wet years) and therefore provides additional passage opportunities in predominantly non-wet years. Table 4-1 presents the passage opportunities in those years when passage flow supplementation would have occurred under the Proposed Operations based on analysis of the SYRHM (1942 to 1993). The passage flow releases under the Proposed Operations would have provided 166% more passage opportunities than Baseline Operations in the slightly less than a third of years in which supplementation would have occurred. An additional third of the years are historically wet years, suggesting that steelhead will have at least fourteen days of passage in roughly two-thirds of the years. For the 14 years when passage flow releases would have been made, historically there were still more passage days than under the Proposed Operations overall. However, Historical conditions would have only provided at least 14 days of passage per year in eight out of the fourteen years.

Table 4-1 Passage Opportunities in the Santa Ynez River in Years Based on Modeled Fish Passage Account Releases

		Without Cachuma Operations (Historical)		Baseline Operations		Long-Term Passage Proposal (3.0' Surcharge, 3,200 AF)			Interim Passage Proposal (1.8' Surcharge, 2,500 AF)		
Year	**Hydrologic Year Type[1]**	**# of Passage Days[2]**	**Indicator of ³ 14 days**	**# of Passage Days[2]**	**Indicator of ³ 14 days**	**# of Passage Days[2]**	**Add'l Days from Baseline**	**Indicator of ³ 14 days**	**# of Passage Days[2]**	**Add'l Days from Baseline**	**Indicator of ³ 14 days**
1949	dry	1		1		15	14	X	15	14	X
1950	dry	1		0		14	14	X	8	8	
1953	normal	51	X	3		17	14	X	18	15	X
1954	normal	53	X	7		26	19	X	20	13	X
1959	normal	47	X	2		15	13	X	15	13	X
1960	dry	0		1		15	14	X	12	11	
1968	dry	24	X	1		15	14	X	15	14	X
1970	normal	72	X	11		16	5	X	15	4	X
1975	normal	89	X	68	X	74	6	X	75	7	X
1976	dry	2		1		16	15	X	16	15	X
1981	normal	64	X	10		22	12	X	21	11	X
1982	normal	35	X	6		19	13	X	18	12	X
1987	dry	0		0		16	16	X	15	15	X
1988	dry	12		0		15	15	X	9	9	
Average		32		8		21	13		19	12	
Sum		451		111		295			272		
Number of years with ³ 14 days of passage			8 57%		1 7%			14 100%			11 79%

[1]A 'wet' year is the third of the years analyzed with the greatest inflow into Lake Cachuma, 'normal' years were the middle third of years, and 'dry' years were the third of years with the lowest inflow into Lake Cachuma using USGS Los Laureles gage data.

[2]A 'passage day' is defined as flow at Solvang (Alisal Reach) of greater than or equal to 25 cfs.

4.2.3 EFFECTS ON SPAWNING HABITAT

4.2.3.1 Methods for Spawning and Rearing Habitat Analysis

The spawning habitat analysis (in this section) and rearing habitat analysis (in the next section) are both based on the habitat studies performed by the SYRTAC (1999a, Section 2.1). These analyses focus on the upper part of the mainstem from Alisal Bridge to Bradbury Dam because the river below the Alisal Reach does not appear to support rainbow trout/steelhead. Despite many snorkel surveys since 1995 (SYRTAC 1997, 1998, 2000), only one rainbow trout/steelhead has been observed below this reach. This adult fish was found below Buellton in a pool at Santa Rosa Park in 1998, an extremely wet year (SYRTAC data).

For purposes of this analysis, the average top width versus flow relationship was generated by weighting the top width of each habitat type by its relative proportion in each reach. The average top width was converted to acres of habitat by multiplying the average top width by the length of habitat in each reach. For the spawning analysis, usable habitat was limited to riffles and runs. In the rearing habitat analysis, it was assumed that only pool habitats remained when flow was zero and all other habitat types provided no habitat. This likely results in an overestimate of habitat under zero flow conditions, as the pools likely shrink by an unknown amount both in length and width, and an unknown number of pools likely dry up completely. Regardless of this overestimate, the analysis does provide a basis for making a comparison between the Baseline and Proposed Operations, as both are evaluated under the same assumptions.

Flow exceedance curves were developed from the daily flows generated from the Santa Ynez River model for three locations: (1) below the confluence of Hilton Creek (representing the Highway 154 Reach), (2) at Highway 154 (representing the Refugio Reach), and (3) at Alisal Bridge (representing the Alisal Reach) based on model simulations including a 52-year period of record (1941 to 1993). Four seasons were used in the rearing habitat analysis: (1) January 1 through March 31, (2) April 1 through June 30, (3) July 1 through September 30, and (4) October 1 through December 31. For the spawning analysis, only the January through April period was used. The model included both Fish Passage Account releases, reservoir releases to meet mainstem rearing target flows, and downstream water rights releases.

4.2.3.2 Spawning Results

The relative availability of spawning habitat among the three operational scenarios is similar in the three reaches (Table 4-2). In general, both Interim phases have similar spawning habitat. Long-Term Operations have slightly more spawning habitat than Interim Operations in normal and dry years because target flows are maintained through conjunctive use releases and passage flow supplementation releases are made in these years. Long-Term Operations provide more habitat in dry years than the Historic (17% to 655% in the upper two reaches respectively) or Baseline Operations (1,562% more in the upper reach). Neither the Historic Conditions

Table 4-2 Flow and Available Spawning Habitat under Different Operation Scenarios

Condition	Dry Years 80% exceedance[1]			Normal Years 50% exceedance[1]			Wet Years 20% exceedance[1]		
	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)
Bradbury Dam to Highway 154									
Historic	1.6	4.1	17	20.1	6.2	-10	164.1[3]	8.0	-18
Baseline	0.2	0.3	1562	1.0	2.6	115	44.7	6.6	0
Long Term	3.4	4.8	-	5.6	5.6	-	50.2	6.6	-
Int: 0.75	2.5	4.5	-	3.3	4.8	-	45.7	6.6	-
Int: 1.8	2.6	4.6	-	3.3	4.8	-	49.1	6.6	-
Highway 154 to Refugio Road									
Historic	0.3	0.4	655	18.9	4.0	-16	167.1[3]	5.2	-12
Baseline	0.0	0.0	+++[4]	0.9	1.7	94	51.3	4.6	0
Long Term	3.1	3.3	-	5.0	3.4	-	58.2	4.6	-
Int: 0.75	2.4	3.2	-	2.9	3.3	-	51.3	4.6	-
Int: 1.8	2.4	3.2	-	3.0	3.3	-	59.6	4.6	-
Refugio Road to Alisal Bridge									
Historic	0.0	0.0	+++[4]	15.9	8.5	-16	174.9[3]	12	-11
Baseline	0.0	0.0	+++[4]	1.3	5.3	36	66.8	10.5	2
Long Term	1.4	5.7	-	4.6	7.2	-	76.5	10.7	-
Int: 0.75	0.3	0.9	-	2.9	6.7	-	69.9	10.5	-
Int: 1.8	0.3	0.9	-	3.1	6.8	-	74.9	10.6	-

[1]Dry years are represented by an 80% exceedance for all years in the model (for example, under Historic conditions from the Dam to HWY 154, 80% of the time flows are greater than 1.6 cfs); Normal years are represented by a 50% exceedance and Wet years by a 20% exceedance.

[2]Based on change in habitat area relative to the Long-Term Operations

[3]Estimated habitat; flows exceed predictive reliability of habitat-flow relationship

[4]Percentage increase could not be calculated because there was no available habitat for this condition

or Baseline Operations provide spawning habitat in the Alisal Reach in dry years. Nor do the Baseline Operations provide spawning habitat in dry years in the Refugio Reach. Long-Term Operations provide between 36% and 115% more spawning habitat than the Baseline Operations in normal years, and similar amounts in wet years.

In normal and wet years, Long-Term Operations provide somewhat less habitat than the Historic Condition. In normal years, Long-Term Operations provide 10% to 16% less habitat and, in wet years, provide 11% to 18% less habitat as compared to the Historic Condition. The lower amount of spawning habitat in normal and wet years is likely inconsequential relative to the substantially increased availability of this habitat in dry years. Substantial production of rainbow trout/steelhead has been observed in the Santa Ynez River in wet years like 1995 and 1998. In these years, there appears to be sufficient spawning success to fully utilize the available rearing habitat. In dry years, lack of spawning habitat under the Baseline Operations and Historic Condition results in under-utilization of available rearing habitat. This was identified as a significant limiting factor in the Contract Renewal EIS/EIR (Woodward-Clyde Consultants *et al.*, 1995).

4.2.4 EFFECTS ON REARING HABITAT

In general, both phases of Interim Operations provide similar amounts of habitat. Long-Term Operations provide slightly more habitat than the Interim Operations in most seasons and reaches. The largest difference between Interim and Long-Term Operations is found in normal years in the Alisal Reach where Long-Term Operations will provide 10.8 acres of habitat, but Interim Operations provide less than an acre. This is due to the long-term provision of higher target flows at the Highway 154 Bridge and providing 1.5 cfs to Alisal in spill years and the year after a spill.

4.2.4.1 Bradbury Dam to Highway 154

Long-Term Operations provide consistently more habitat in dry years and, more importantly, during the latter half of normal or wet years than either the Baseline Operations or Historic Conditions. In dry years, Long-Term Operations result in flows of 3.1 to 6.2 cfs below the confluence of Hilton Creek, while flows under the Baseline Operations range from 0 to 6 cfs, and the Historic Condition results in flows of 0 to 2 cfs (Table 4-3). The increase in flow over the Baseline Operations translates into a gain in habitat for this reach of over 13 acres during the July through September period, and nearly 18 acres or 74% more habitat than the Baseline Operations during the October through December period, and 74% more habitat than was available prior to the construction of Bradbury Dam.

In normal years, Long-Term Operations continue to provide more flow below the Hilton Creek confluence than does the Baseline Operations. The difference in the amount of habitat available is relatively minor (about 2%) during the middle portion of the year (April through September), but is significant during the January through April period and October through December period where Long-Term Operations provide 30% and 45% more habitat than the Baseline Operations. The Baseline and Long-Term Operations provide a similar amount of habitat in wet years.

Table 4-3 Rearing Habitat between Bradbury Dam and Highway 154

Quarter		Dry Years 80% exceedance[1]			Normal Years 50% exceedance[1]			Wet Years 20% exceedance[1]		
		Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)
Jan-Mar	Historic	1.2	36.5	14	18.1	46.3	-7	157.7[3]	51.9	-8
	Baseline	0.2	25.3	64	0.9	33.2	30	21.3	46.8	3
	Long Term	3.1	41.6	-	5.4	43.2	-	33.0	48.0	-
	Int: 0.75	2.4	40.9	-	3.2	41.7	-	21.1	46.8	-
	Int: 1.8	2.5	41.0	-	3.2	41.7	-	30.1	47.8	-
Apr-Jun	Historic	2.0	40.5	7	13.1	45.3	-4	77.0	50.4	-2
	Baseline	0.6	29.8	45	4.3	42.5	2	56.7	49.1	0
	Long Term	5.0	43.1	-	6.2	43.4	-	51.0	49.2	-
	Int: 0.75	3.1	41.6	-	5.4	43.2	-	55.7	49.5	-
	Int: 1.8	3.0	41.6	-	4.6	42.7	-	53.9	49.4	-
Jul-Sep	Historic	0.0	24.2	79	0.0	24.2	86	2.6	41.1	19
	Baseline	0.6	29.8	46	7.7	43.8	2	43.4	48.7	0
	Long Term	6.2	43.4	-	11.5	44.9	-	46.0	48.8	-
	Int: 0.75	4.1	42.4	-	6.8	43.6	-	46.9	49.0	-
	Int: 1.8	3.6	42.0	-	7.1	43.6	-	44.3	48.7	-
Oct-Dec	Historic	0.0	24.2	74	0.0	24.2	79	3.2	41.7	6
	Baseline	0.0	24.2	74	0.6	29.8	45	6.1	43.4	2
	Long Term	3.7	42.1	-	5.9	43.3	-	9.9	44.4	-
	Int: 0.75	2.6	41.1	-	3.4	41.9	-	5.4	43.2	-
	Int: 1.8	2.6	41.1	-	3.4	41.9	-	5.3	43.1	-

[1]Dry years are represented by an 80% exceedance for all years in the model (for example, under Historic conditions from the Dam to HWY 154, 80% of the time flows are greater than 1.6 cfs); Normal years are represented by a 50% exceedance and Wet years by a 20% exceedance.
[2]Based on change in habitat area relative to the Long-Term Operations
[3]Estimated habitat; flows exceed predictive reliability of habitat-flow relationship

Flows resulting from the Historic Condition are greater than either Long-Term or Baseline Operations in the first half of normal and wet years. However, in the later portion of normal years, Historic Conditions have severely reduced habitat when flow is zero and habitat is available only in refuge pools. Long-Term Operations result in about 4% to 7% less habitat during the first half of normal years, and about 79% to 86% more habitat in the latter half of the year than the Historic Condition. In wet years, the Historic Condition retains flow throughout the year, but under Long-Term Operations between 6% and 19% more habitat is available.

4.2.4.2 Highway 154 to Refugio Road

The flows at Highway 154 were used to characterize habitat in the reach from Highway 154 to Refugio Road (Table 4-4). The flow at Highway 154 tends to be less than that below the Hilton Creek confluence for all conditions due to infiltration and evapotranspiration. The pattern of habitat availability among the different scenarios is similar to that described above for the Bradbury Dam to Highway 154 Reach, with Long-Term Operations providing the most habitat throughout the year in dry years and in the latter half of normal and wet years. Minimum habitat levels are highest under Long-Term Operations.

In dry years, the Long-Term Operations provide about seven more acres of habitat than the Baseline Operations, representing more than a seven-fold increase in the amount of available habitat. Long-Term Operations also provide an increase in habitat over the Historic Condition of 4.1 to 7.5 acres in dry years. In normal years, Long-Term and Baseline Operations provide about the same amount of habitat during the middle part of the year, but Long-Term Operations provide 93% and 482% (4.1 and 7 acres) more habitat in the January through March and October through December periods, respectively. Long-Term Operations provide 7.5 to 8 times more habitat than does the Historic Condition in the latter half of normal years, although the Historic Condition provides 8% to 10% more habitat in the first half of normal years. In wet years, Long-Term and Baseline Operations provide a similar amount of habitat throughout the year, never differing by more than .4 acres or about 4%. The Historic Condition in wet years provides 3% to 18% more habitat during the first half of the year than does Long-Term Operations. This increased habitat during the first part of the year is offset by diminished habitat in the latter half of the year when Long-Term Operations provide 1.5 to 2.4 acres (21% to 31%) more habitat.

4.2.4.3 Refugio Road to Alisal Road

The flows at Alisal Bridge were used to characterize the habitat in the reach from Refugio Road to Alisal Road. Flow at Alisal Road is less than that for Highway 154 and the Hilton Creek confluence under most conditions due to continued losses to groundwater and evapotranspiration. Under Historic Conditions, flow is nearly absent from this location in all water year types during the July through September and October through December periods (Table 4-5). Flows under Long-Term Operations are greater than those under the Baseline Operations, except in the July through September period of wet years when they are the same.

Table 4-4 Rearing Habitat between Highway 154 and Refugio Road

Quarter		Dry Years 80% exceedance[1]			Normal Years 50% exceedance[1]			Wet Years 20% exceedance[1]		
		Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)
Jan-Mar	Historic	0.3	2.0	325	17.4	9.5	-10	157.1[3]	11.2	-8
	Baseline	0.0	1.0	730	0.8	4.4	93	28.6	9.9	4
	Long Term	3.1	8.3	-	5.0	8.5	-	40.9	10.3	-
	Int: 0.75	2.3	8.1	-	2.8	8.2	-	27.5	9.9	-
	Int: 1.8	2.4	8.1	-	2.9	8.2	-	40.0	10.2	-
Apr-Jun	Historic	0.8	4.4	93	12.1	9.2	-8	75.3	10.8	-3
	Baseline	0.1	1.0	776	4.0	8.4	1	51.9	10.5	0
	Long Term	4.9	8.5	-	5.0	8.5	-	49.9	10.5	-
	Int: 0.75	2.5	8.1	-	5.0	8.5	-	52.5	10.4	-
	Int: 1.8	2.4	8.1	-	4.4	8.5	-	52.2	10.4	-
Jul-Sep	Historic	0.0	1.0	750	0.0	1.0	810	1.6	7.9	31
	Baseline	0.1	1.0	776	6.4	8.7	5	39.7	10.2	1
	Long Term	4.9	8.5	-	10.1	9.1	-	42.0	10.3	-
	Int: 0.75	2.9	8.2	-	6.5	8.7	-	41.0	10.3	-
	Int: 1.8	2.4	8.1	-	6.8	8.7	-	41.7	10.3	-
Oct-Dec	Historic	0.0	1.0	710	0.0	1.0	750	1.4	7.4	21
	Baseline	0.0	1.0	710	0.2	1.5	482	5.1	8.5	4
	Long Term	2.5	8.1	-	4.9	8.5	-	8.8	8.9	-
	Int: 0.75	1.5	7.8	-	2.5	8.1	-	4.6	8.5	-
	Int: 1.8	1.5	7.8	-	2.5	8.1	-	4.2	8.5	-

[1]Dry years are represented by an 80% exceedance for all years in the model (for example, under Historic conditions from the Dam to HWY 154, 80% of the time flows are greater than 1.6 cfs); Normal years are represented by a 50% exceedance and Wet years by a 20% exceedance.
[2]Based on change in habitat area relative to the Long-Term Operations
[3]Estimated habitat; flows exceed predictive reliability of habitat-flow relationship

In dry years, the long-term condition is the only operation that provides flow at Alisal Bridge, although there is no flow from October through December. Flow ranges from .8 cfs in the July through September period to 2.2 cfs in the April through June period. These flows provide between 5.4 and 11.2 acres of habitat, compared to the .1 acres provided by the other conditions. In the middle portion of normal years, the amount of habitat provided by Long-Term Operations is about 11% greater than that available under the Baseline Operations. In the January through March period, however, Long-Term Operations provide 58% more habitat than does the Baseline Condition; and in the October through December period, Long-Term Operations provide over 100 times the habitat as flow under the Baseline Operations is zero. The Historic Condition provides about 8% to 15% more habitat than Long-Term Operations in the first half of normal years, but then flow under the Historic Conditions dries up, and little habitat is available for fish in the second half of the year. During the second half of the year, Long-Term Operations provide between 10.8 and 12.8 acres of habitat compared to .1 acres for the Historic Condition.

In wet years, Long-Term and Baseline Operations provide a similar amount of habitat throughout the year, with the largest difference in the October through March periods when Long-Term Operations offer 6% to 10% more habitat than does Baseline Operations. The Historic Condition in wet years provides about 2.9 acres (10%) more habitat than does Long-Term Operations during January through March. In the latter part of the year, however, the flow under the Historic Condition subsides to .1 cfs, and only .1 acres of habitat are available. Long-Term Operations provide 12.6 acres of habitat during this time of year, representing a substantial increase.

4.2.5 Effects on Minimum Flows

The minimum daily flow during a year represents the most severe bottleneck in rearing habitat that steelhead will face. Minimum daily flows were modeled for the same three stations used for the habitat analysis: below the confluence with Hilton Creek, at theHighway 154 Bridge, and at the Alisal Road Bridge. Under Proposed (long-term) Operations at Alisal, minimum daily flows would generally be much lower than in the mainstem below Hilton Creek or the Highway 154 Bridge, but would remain substantially better than the flows present under the Historic Conditions or Baseline Operations. Under the Historic Condition, all sites have little or no flow during a portion of the year, in all year types (Table 4-6). Under the Baseline Operations, a similar situation prevails, such that there is a small amount of flow (<1 cfs) present below the Hilton Creek confluence in about a third of all years. The river would go dry for at least one day in most years at both the Highway 154 and Alisal sites. Under the Proposed Operations, the minimum daily flow would approach zero below Hilton Creek in three years (1951, 1952, and 1991), all occurring at the end of prolonged droughts. During these years, dissolved oxygen, temperature, and water levels in pools in the upper reaches of the mainstem would be maintained by refreshing flows from the dam. At Highway 154, the minimum daily flow would be at least 2.5 cfs in all but three years, and would be at least 5 cfs in 58% of years. At the Alisal Bridge, the minimum flow would be at least 1.5 cfs in 38% of years.

Table 4-5 Rearing Habitat between Refugio Road and Alisal Road

Quarter		Dry Years 80% exceedance[1]			Normal Years 50% exceedance[1]			Wet Years 20% exceedance[1]		
		Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)	Flow (cfs)	Habitat Area (acres)	Change under Long-Term Operations[2] (%)
Jan-Mar	Historic	0.0	0.1	9,900	14.0	14.3	-15	161.6[3]	19.4	-10
	Baseline	0.0	0.1	9,900	1.1	7.7	58	38.7	16.6	6
	Long Term	1.4	10.0	-	4.2	12.2	-	58.8	17.5	-
	Int: 0.75	0.2	0.8	-	2.7	11.5	-	41.5	16.7	-
	Int: 1.8	0.2	0.8	-	2.6	11.4	-	54.7	17.3	-
Apr-Jun	Historic	0.0	0.1	11,100	9.4	13.6	-8	77.6	18.1	-6
	Baseline	0.0	0.1	11,100	3.0	11.7	7	44.6	16.9	0
	Long Term	2.2	11.2	-	5.1	12.5	-	46.0	17.0	-
	Int: 0.75	0.4	2.4	-	4.4	12.3	-	45.7	17.0	-
	Int: 1.8	0.4	2.4	-	4.1	12.2	-	45.5	17.0	-
Jul-Sep	Historic	0.0	0.1	5,300	0.0	0.1	12,700	0.1	0.1	26,694
	Baseline	0.0	0.1	5,300	2.8	11.6	11	30.2	16.0	0
	Long Term	0.8	5.4	-	6.1	12.8	-	30.9	16.0	-
	Int: 0.75	0.0	0.1	-	3.9	12.1	-	28.4	15.8	-
	Int: 1.8	0.0	0.1	-	4.0	12.2	-	27.8	15.8	-
Oct-Dec	Historic	0.0	0.1	0	0.0	0.1	10,700	0.1	0.1	21,000
	Baseline	0.0	0.1	0	0.0	0.1	10,700	2.7	11.5	10
	Long Term	0.0	0.1	-	1.5	10.8	-	5.3	12.6	-
	Int: 0.75	0.0	0.1	-	0.2	0.8	-	4.5	12.3	-
	Int: 1.8	0.0	0.1	-	0.1	0.1	-	4.2	12.2	-

[1]Dry years are represented by an 80% exceedance for all years in the model (for example, under Historic conditions from the Dam to HWY 154, 80% of the time flows are greater than 1.6 cfs); Normal years are represented by a 50% exceedance and Wet years by a 20% exceedance.

[2]Based on change in habitat area relative to the Long-Term Operations

[3]Estimated habitat; flows exceed predictive reliability of habitat-flow relationship

4.2.6 DOWNSTREAM WATER RIGHTS RELEASES

The potential exists for steelhead to move downstream during water rights releases. Surveys have been conducted to assess the presence and index of relative abundance of juvenile and adult trout within the area of the Stilling Basin and Long Pool, and in the Refugio and Alisal Reaches prior to and after WR 89-18 releases. Field surveys have been conducted during the recession phase of WR 89-18 releases and after the releases have been completed, to assess fish stranding within pools and other habitats in downstream areas. The result of these field surveys, performed under the guidance of the SYRTAC, is that no strandings have been observed during ramping events and no downstream migration of rainbow trout/steelhead as a result of these releases has been noted. As part of the ongoing fishery monitoring program, additional field surveys and observations will be collected to provide information on movement patterns and the response of rainbow trout to WR 89-18 releases (see Appendix I, Long-Term Monitoring in the Lower Santa Ynez River).

4.3 EFFECTS ON OTHER SPECIES

4.3.1 OTHER FISH IN THE SANTA YNEZ RIVER

Flow-related fish enhancement measures will only affect Lake Cachuma, the mainstem below Bradbury Dam, and Hilton Creek below the upper watering system release site. Mainstem target flow releases will not persist far enough downstream to impact the lagoon, however passage flow releases will likely modify the flow regime to the lagoon to some extent. Impacts to the six native fish species that reside only in the lagoon, as well as the other fish in the mainstem Santa Ynez River, are expected to be negligible because of the nature of the supplementation passage flow releases. Releases from the Fish Passage Account have been designed to mimic the hydrograph of naturally occurring storms (*i.e.,* match the average inflow decay rate). The magnitude of the supplemental flow is well within the range of existing storm flows, and therefore no adverse impacts are anticipated on these sensitive resources. Pacific lamprey, however, are expected to benefit from these releases because they, like steelhead, are anadromous. The additional passage opportunities provided by the Fish Passage Account will benefit this species as well by increasing migration opportunities.

The flow-related enhancement measures should beneficially impact all of the fish inhabiting the mainstem near Bradbury Dam. Conjunctive use of reservoir releases and downstream water rights releases to meet mainstem rearing target flows will benefit these fish by improving over-summering habitat in the mainstem downstream of Bradbury Dam. Late summer and early fall are critical periods for fish in the Santa Ynez River system because warm temperatures and shrinking pool habitat lead to a habitat bottleneck. The Proposed Operations will provide water to maintain pool habitat during this critical period in all but the driest years. The Proposed Operations may potentially have a negative impact on introduced species in the mainstem below Bradbury Dam because the majority of these fish are warmwater species. Rearing target flow

Table 4-6 Minimum Flow by Water Year (cfs)

Water Year	Without Cachuma Operations			Baseline Operations			Proposed Operations (long term)		
	Below Hilton Ck	Hwy 154 Bridge	Alisal Bridge	Below Hilton Ck	Hwy 154 Bridge	Alisal Bridge	Below Hilton Ck	Hwy 154 Bridge	Alisal Bridge
1942	0	0	0	0.5	0.5	0	2	5	3
1943	0	0	0	0.5	0	0	6	5	0.5
1944	0	0	0	0.5	0	0	4.5	5	1.5
1945	0	0	0	0.5	0	0	2.5	5	1.5
1946	0	0	0	0.5	0	0	2.5	5	2
1947	0	0	0	0	0	0	5.5	5	2
1948	0	0	0	0	0	0	3.5	2.5	0
1949	0	0	0	0	0	0	2	2.5	0
1950	0	0	0	0	0	0	2	2.5	0
1951	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	2	5	1.5
1954	0	0	0	0.5	0	0	2	5	1.5
1955	0	0	0	0	0	0	2	2.5	0
1956	0	0	0	0	0	0	1	2.5	0
1957	0	0	0	0	0	0	2.5	2.5	0
1958	0.5	0	0	0	0	0	2	2.5	0
1959	0	0	0	0	0	0	2	5	1.5
1960	0	0	0	0	0	0	3.5	2.5	0
1961	0	0	0	0	0	0	3.5	2.5	0
1962	0	0	0	0	0	0	1	2.5	0
1963	0	0	0	0	0	0	2	5	0.5
1964	0	0	0	0	0	0	3.5	2.5	0
1965	0	0	0	0	0	0	2	2.5	0
1966	0	0	0	0	0	0	1	2.5	0
1967	0	0	0	0.5	0.5	0.5	2	5	2
1968	0	0	0	0	0	0	4.5	5	1.5
1969	0	0	0	0	0	0	6	5	2
1970	0	0	0	0.5	0	0	3	5	1.5
1971	0	0	0	0.5	0	0	3.5	5	2
1972	0	0	0	0	0	0	3	5	0
1973	0	0	0	0	0	0	2	2.5	0
1974	0	0	0	0.5	0	0	2	5	2.5
1975	0	0	0	0	0	0	2	5	1.5
1976	0	0	0	0	0	0	4.5	5	0.5
1977	0	0	0	0	0	0	3.5	2.5	0
1978	0	0	0	0	0	0	2	2.5	0
1979	0	0	0	0.5	0	0	2	5	1.5
1980	0	0	0	0.5	0	0	2.5	5	1.5
1981	0	0	0	0.5	0	0	2	5	1.5
1982	0	0	0	0.5	0	0	2	5	2
1983	1	0.5	0	0	0	0	2	5	2
1984	0.5	0	0	1	0.5	0	4.5	5	3
1985	0	0	0	0.5	0	0	5	5	1
1986	0	0	0	0	0	0	2	5	1.5
1987	0	0	0	0	0	0	3.5	5	0.5
1988	0	0	0	0	0	0	4.5	5	0.5
1989	0	0	0	0	0	0	3	2.5	0
1990	0	0	0	0	0	0	3.5	2.5	0
1991	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	2	2.5	0
1993	0	0	0	0	0	0	5.5	5	3

releases will be of water temperatures less than 18°C. Low temperatures can negatively affect warmwater species by lowering their metabolism and slowing growth rates. Because water in the mainstem warms quickly as it passes downstream, these affects are expected to be minimal and will likely be offset by the habitat maintenance these releases provide. In addition, some warm water fish have been observed to be transported downstream due to water rights releases. Water releases into Hilton Creek through the supplemental watering facilities will directly benefit the sculpin, which presently reside in Hilton Creek. The watering system will provide critical over-summering habitat away from mainstem predatory fish.

4.3.2 WILDLIFE

Flow-related fish enhancement measures will only affect Lake Cachuma, the mainstem below Bradbury Dam, and Hilton Creek below the upper watering system release site. Most of the proposed flow enhancements will not persist far enough downstream to impact the mainstem downstream of Buellton including the lagoon, however passage flow releases will likely modify the flow regime to the lagoon to some extent. The passage releases should have no effect on southwestern willow flycatcher (populations found near Buellton and Lompoc) and least Bell's vireo (near Salsipuedes Creek in Lompoc). The magnitude of the supplemental flow is well within the range of existing storm flows, and therefore no adverse impacts are anticipated on these sensitive resources. The southwestern arroyo toad (found only upstream of Gibraltar Reservoir) and the California tiger salamander (not found near the mainstem) will not be impacted by any of the Proposed Operations.

The southwestern willow flycatcher will likely benefit from the target flow releases through the addition of more suitable habitat. The target flow releases are expected to cause increase riparian growth in the Highway 154 Reach and perhaps in the Alisal Reach as well. Southwestern willow flycatchers prefer dense willow riparian habitat which will likely develop because of the year-round water supply provided by the target flows. It is possible that removal of some of this new vegetation will be required, however a net increase in riparian vegetation is anticipated.

The California red-legged frog, western pond turtle, and two-striped garter snake all need water throughout all or a portion of the year and prefer a well developed riparian zone. Mainstem rearing target flow releases into Hilton Creek will produce good habitat by providing a perennial water source with a good riparian zone. None of these three species currently inhabit Hilton Creek. Benefits to the species will only occur if they colonize Hilton Creek. Conjunctive use will extend mainstem summer flows in almost all years, and habitat will be maintained through pool maintenance releases from Bradbury Dam in the remaining years (drought years). These releases will also have the beneficial effect of providing additional mainstem habitat and improving existing habitats through water quality improvements and riparian growth. The habitat enhancement, however, may also benefit bullfrogs, which have been linked to the decline of red-legged frogs and can hurt turtle populations by predation on hatchlings. Bullfrogs are currently found throughout the mainstem.

4.3.3 SPECIES THAT INHABIT LAKE CACHUMA

Surcharging the reservoir to 3 feet is not expected to impact bass, sunfish, and crappie inhabiting Lake Cachuma. Based on a study of the effect of a 1.8 foot surcharge on spawning and fry rearing in the lake (done for the Cachuma contract renewal [ENTRIX 1995]), the impacts of the 1.8-foot surcharge are almost identical to current operations. A 1.2-foot increase beyond the level already determined to have little impact on these fish should not negatively impact spawning. Bass, sunfish, and crappie create their nests over a range of water depths. Once the nests are built, surcharging the reservoir will only submerge these nests to a slightly deeper level. This will not substantially impact the success of the nests. Surcharging the reservoir will not lead to a decrease in spawning habitat and will allow for access to spawning habitat in the lake's tributaries. Catfish spawn in 8- to 12-foot deep water, and therefore nests should not be impacted by changing lake levels. Surcharging the reservoir will not impact the shad, nor will any of the proposed release operations, because shad prefer open surface waters.

Flow-related enhancements have the potential to affect Lake Cachuma resources because they, like water supply deliveries, reduce the lake surface elevation. Decreasing lake surface elevation has the potential to de-water nests prior to fry emergence; however, because of the small shifts in reservoir surface elevation expected as a result of the flow-related enhancements, this should be a negligible impact. None of the proposed releases (target flows or Fish Passage Account) will dramatically change the reservoir surface elevation in a short period of time. For the steelhead spawning period of January through May, analysis shows that the largest projected release for passage supplementation would be 1,800 AF over at least two 14-day periods. The surface area of Lake Cachuma is approximately 3,000 acres at a reservoir surface elevation of 750 feet. Because of the large surface area of the lake, the 1,800 AF release will amount to a decrease in reservoir surface elevation of slightly more than .5 feet. Such a small change in surface elevation will have the potential to de-water only the most shallow of nests. Bass, sunfish, and crappie generally do not create nests in water shallower than .5 feet, and therefore few if any nests should be impacted by these operations. Water fluctuations should not affect shad because spawning occurs on floating or partially submerged vegetation or other structures.

The flow-related enhancement measures described in this document will provide substantial benefits to the steelhead population. Through conjunctive use of reservoir releases and downstream water rights accounts to meet mainstem rearing target flows, year-round habitat for steelhead can be created in both the mainstem Santa Ynez River and Hilton Creek. These measures will significantly expand the amount of habitat available for steelhead rearing and over-summering, which has been identified as the primary limiting factor in the mainstem Santa Ynez River. In wet years, higher rearing flow target levels will provide more habitat than in normal and dry years. This leverages the use of water to provide higher levels of habitat when there will likely be more steelhead in the river (*i.e.,* in highly productive wet years), and to support less habitat when there are fewer steelhead in the river and when water supplies are lower (*i.e.,* in less productive dry years). The habitat created and enhanced by these measures is located in the portion of the river with the best structural habitat and the greatest opportunity to control water temperatures, which limits the distribution of steelhead in most of the river.

Passage flow release substantially increase the number of passage opportunities over Baseline conditions in those years when releases are made. The combination of good passage opportunities in wet years and Fish Passage Account releases in non-wet years provide at least 14 passage days in about two-thirds of years. Passage supplementation combined with rearing flow targets should provide a considerable benefit to rainbow trout/steelhead in the Santa Ynez River watershed.

The Conjunctive Use Work Group recommends that conjunctive use of reservoir releases and downstream water rights releases be implemented immediately at the interim levels. This includes surcharging the reservoir to 0.75 feet to support the flow-related enhancement actions. The dam modifications necessary to implement a greater surcharge should be completed as soon as possible in order to begin Fish Passage Account releases. Finally, the environmental review necessary to obtain the proposed 3-foot surcharge of Lake Cachuma should be completed as soon as possible. This action will allow for implementation of the long-term enhancement measures: (1) long-term rearing target flows, (2) full Fish Passage Account allocation of 3,200 AF, and (3) the Adaptive Management Account allocation of 500 AF. In addition, the monitoring program discussed in Appendix I should be implemented immediately to continue gathering data appropriate for implementation and evaluation of these measures by the Adaptive Management Committee.

ENTRIX. 1995a. Fish resources technical report for the EIS/EIR, Cachuma Project Contract Renewal. December 5, 1995. Prepared for Woodward-Clyde Consultants.

NMFS. 2000. Biological Opinion. U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, CA. September 11, 2000.

Santa Ynez River Technical Advisory Committee. 1997. Synthesis and Analysis of Information on the Fisheries Resources and Habitat Conditions of the Lower Santa Ynez River: 1993-1996. Prepared for Santa Ynez River Consensus Committee, Santa Barbara, CA.

Santa Ynez River Technical Advisory Committee. 1998. Data Compilation Report for 1996-1997. Prepared for Santa Ynez River Consensus Committee, Santa Barbara, CA. Draft report.

Santa Ynez River Technical Advisory Committee. 1999a. Steelhead habitat analysis for the Santa Ynez River, CA. Draft report. Prepared for Santa Ynez River Consensus Committee, Santa Barbara, CA.

Santa Ynez River Technical Advisory Committee. 1999b. Adult steelhead passage analysis for the Santa Ynez River, CA. Draft report. Prepared for Santa Ynez River Consensus Committee, Santa Barbara, CA.

Santa Ynez River Technical Advisory Committee. 2000. Data Compilation Report for 1998-1999. Prepared for Santa Ynez River Consensus Committee, Santa Barbara, CA. Draft report.

Shapovalov, L. 1944. Preliminary Report on the Fisheries of the Santa Ynez River System, Santa Barbara County, California. California Department of Fish and Game Report: 22pp.

Titus, R. G., D. C. Erman and W. M. Snider. 1994. History and status of steelhead in California coastal drainages south of San Francisco Bay. Manuscript, September 27, 1994, accepted for publication in *Hilgardia*.

U. S. Bureau of Reclamation. 1998. Report of Findings: Lake Cachuma Surcharge Study – Bradbury Dam 1.8 and 3-foot surcharge increments. Prepared by W.R. Fielder for the Santa Barbara County Flood Control and Water Conservation District and Water Agency. November 1998.

Woodward-Clyde Consultants. 1995. Final Environmental Impact Report/Statement. Cachuma Project Contract Renewal: Volume I.

Adams, J. 1994. Personal communication. California Department of Fish and Game, Hatchery Manager, Filmore Fish Hatchery, California. *In*: Woodward-Clyde Consultants. 1995. Final Environmental Impact Report/Statement. Cachuma Project Contract Renewal: Volume I.

Engblom, S. 2000. Personal communication to Kindra Loomis (ENTRIX). SYRTAC Project Biologist.